15 Years of Research on Graduate Education in Economics: What Have We Learned?

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ABSTRACT

This paper summarizes our 15 years of research on graduate education in economics in the US. We examine all stages of the process, from the undergraduate origins of eventual economics Ph.D.s. to their attrition and time-to-degree outcomes. For Ph.D. completers, we examine job market outcomes, research accomplishments, and career paths over the first five and ten years of their careers.

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Introduction

Each year, thousands of students begin doctoral studies at one of the 141 economics Ph.D. programs in the United States.[2] The students enter with varying degrees of economics, mathematics, and other training in preparation for graduate school. They increasingly come from divergent demographic and national backgrounds and with a wide array of career goals. About one-fourth of these students succeed at completing the economics Ph.D. within five years, and almost 60 percent succeed in completing the Ph.D. within eight years. For better or worse, approximately 40 percent of entering students are unlikely to ever earn a Ph.D. in economics.

Almost all of those who complete their degree find immediate employment, and the vast majority work in full-time permanent jobs. Almost half change employers within their first six years post-graduation. The primary sector of employment for economics Ph.Ds. is academia, followed distantly by government, international organizations, and research organizations, and even more distantly by business/industry. Their starting salaries and salary growth over time are strongly associated with their sector of employment, as well as the market conditions at the time they completed their Ph.D.

Over the past fifteen years, we have undertaken a project to investigate many aspects of economics Ph.D. education, including the undergraduate origins of eventual economics Ph.Ds., the levels and factors associated with matriculation into and attrition from economics Ph.D. programs, the time it takes to earn a Ph.D. in economics, the eventual labor market and career outcomes, and the match between skills learned in graduate school and those economists use on the job. In this paper, we provide a summary of this work.

Data

The data for this project have come primarily from two types of sources. First, we documented the career progress after degree completion for two graduating cohorts of

[2] The American Economic Association "Graduate Study in Economics Web Pages" at www.aeaweb.org/gradstudents lists all of the economics PhD programs in the US.

economics Ph.Ds.: those who completed degrees between July 1, 1996 and June 30, 1997, (the "class of 1997"), and those who completed degrees between July 1, 2001 and June 30, 2002 (the "class of 2002"). We identified the population of graduates for each of these cohorts via the listings of dissertations in the December 1997 (for the class of 1997) and 2002 (for the class of 2002) *Journal of Economic Literature*.[3] We estimated that about 950 economics Ph.Ds. were awarded by US Ph.D. programs in 1996-97 and about 850 were awarded in 2001-02.[4] We sent each of the graduates a questionnaire asking about their employment status and job characteristics, salary, time to degree, and selected demographic characteristics. We also surveyed the dissertation advisors of nonrespondents to the survey of graduates. For each graduating cohort, we received either direct responses or advisor responses for roughly two-thirds of the graduating classes. Finally, we also gathered longer-term career information for the class of 1997 in two resurveys that were conducted in 2002 and 2007, at five and ten years post-graduation.[5]

A second source of data came from tracking the progress of an entering cohort of 586 students who began their Ph.D. studies in the fall of 2002 at one of 27 US economics Ph.D. programs.[6] In the years since they started their Ph.D. programs, we have been able to document the attrition and completion outcomes for all but three of these 586 individuals. These three are still working on their Ph.D. studies after 10 years.

We supplement these primary data with information on Ph.D. dissertations available from the ProQuest database (a depository for dissertations from all disciplines), with publication data available in EconLit, and with the National Science Foundation Survey of Earned Doctorates, which we use as a comparison against our survey data and as an additional source of information on economics Ph.Ds.

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[3] Complete descriptions of the survey methodology, response rates, and sample representativeness for the class of 1997 and class of 2002 are available in Siegfried and Stock, 1999 and Siegfried and Stock, 2004, respectively.

[4] The 2012 Digest of Education Statistics reports in Table 364 that there were 968 doctoral degrees awarded in economics by US universities in 1996-97 and 826 awarded in 2001-02. For more information on differences in the counts of economics Ph.D. degrees awarded as tabulated by different sources, see Finegan (2013).

[5] Information on these surveys is available in Stock and Siegfried (2006d) and (2011).

[6] The programs include 15 of the 22 largest, plus 12 others. Each program graduates an average of at least five Ph.D.s per year. Together the 27 programs produced 42 percent of the Ph.D.s issued by US programs awarding at least one degree from 1998 to 2001. Higher-ranked programs are over-represented: 22 of the 27 are among the top rated 48 programs. Because these programs recruit more qualified students, help them finish faster, and place them in better jobs, our data may understate attrition for the entire population of economics Ph.D. producing programs.

The Undergraduate Origins of Economics Ph.D.s

Students beginning economics Ph.D. programs in the United States arrive with a wide array of backgrounds. As illustrated in Figure 1, the countries from which eventual economics Ph.D.s originate has changed markedly over the past several decades. In 1970, the vast majority of the roughly 950 economics Ph.D.s earned in the US - 76 percent - were earned by male US citizens. Male non-US citizens earned 19 percent of US economics Ph.D.s, while female US citizens and female non-US citizens earned 5 and less than 1 percent, respectively, of the economics Ph.D. degrees awarded in the US in 1970.

The number of Ph.D.s awarded by US economics programs has fluctuated around roughly 1,000 per year since 1970, but the demographic composition of those Ph.D.s has changed dramatically. The share of economics Ph.D.s earned by female US citizens grew from 5 percent in 1970 to a high of 16 percent in the mid-1990s, but has fallen to about 11 percent since then. The share of economics Ph.D.s earned by female non-US citizens was below 1 percent in 1970, hovered at 2 to 3 percent in the early 1980s, but has grown steadily since then, to about 23 percent in the late 2000s. The share earned by male non-US citizens grew from 19 percent in 1970 to a peak of nearly 50 percent in the mid-2000s, but has fallen to 41 percent in 2011. Finally, the share of economics Ph.D.s awarded to male US citizens has declined steadily from 76 percent in 1970 to a low of 22 percent in 2005 and has only recently recovered slightly, to 25 percent in 2011.

The gender and citizenship trends are similar to those in other potential disciplines that those who earn Ph.D.s in economics might have considered, including mathematics and statistics (math), business and management (business), and political science and public administration (political science). Figures 2 through 4 illustrate the trends in US Ph.D.s earned in math, business, and political science, respectively, during 1970 to 2011. As was the case with economics in 1970, the vast majority of Ph.D.s in math (83 percent), business (87 percent), and political science (90 percent) were earned by male US citizens. Since 1970, the proportion of Ph.D.s in these disciplines that were awarded to other groups has grown steadily. From 1970 to 2011, the proportion of US Ph.D.s earned by female US citizens grew from 6 percent to 13 percent in math, from 2 percent to 22 percent in business, and from 5 percent to 34 percent in political science. The

growth in the percent of Ph.D.s in these disciplines awarded to women US citizens over the 1970-2011 period masks relative declines in these values in recent years, however. The proportion of Ph.D.s awarded to women in economics, math, and business peaked in 1997-1999 (at 16, 18, and 28 percent, respectively). The peak in the percent of women US citizens earning PhDs in in political science occurred later, in 2002, when 42 percent of US Ph.D.s were earned by female US citizens.

The growth and decline in the percentage of Ph.D.s awarded to US citizen females is in stark contrast to the trend for non-US citizen females. In all four disciplines, there has been near continuous growth in the share of Ph.D.s earned by non-US citizen women since 1970, with the largest growth occurring in economics (23 percentage points), followed by business (19 percentage points), math (14) and political science (10).

The patterns in Ph.D.s awarded to male non-US citizens also display similar patterns across these disciplines. The percentages of Ph.D.s earned by male non-US citizens peaked in the early 1990s at 42 percent in economics, 43 percent in math, 30 percent in business, and 24 percent in political science. The shares declined during the mid-late 1990s but began climbing again in the early 2000s. In 2011, non-US citizen males earned 41 percent of the US Ph.D.s in economics, 33 percent in math, 25 percent in business, and 16 percent in political science.

We further document the undergraduate origins of individuals who earned economics Ph.D.s in the US in Siegfried and Stock (2007). Consistent with the trends shown in Figure 1, the number of new economics Ph.D.s who earned their undergraduate degrees from US universities fell from a peak of about 800 in 1972 (75 percent of all economics Ph.D.s degrees awarded in the US) to 420 by 2002 (40 percent). Indeed, among the roughly 5,100 individuals who earned a Ph.D. in economics in the US between 1997 and 2002, Seoul National University in South Korea was the undergraduate alma matter for the largest number of them (162). Harvard, the second largest incubator of eventual economics Ph.D.s in the world at that time, graduated fewer than half as many students who went on to earn an economics Ph.D. (74). Harvard was followed closely by National Taiwan University (63 eventual Ph.D.s) and the University of Delhi (61).

For the roughly 40 percent of economics Ph.D. graduates in 2002 who completed their undergraduate degrees in the United States, the majority (55 percent) earned their bachelor's degrees from a research university that also grants economics Ph.D.s (top sources here are Harvard, Berkeley, Cornell, and Stanford). Roughly 15 percent earned their undergraduate degrees from top-50 liberal arts colleges (e.g., Swarthmore, William and Mary, Williams), and a similar percentage earned their undergraduate degrees from public colleges that do not offer a Ph.D. in economics (e.g., Montana State, Cal-State) and from other private colleges (e.g., Brigham Young, Hillsdale College) (Siegfried and Stock, 2007, Table 3).

That large research universities are a primary source of eventual economics Ph.D.s is no surprise. What is surprising, however, is that after adjusting for the size of their undergraduate economics programs, liberal arts colleges represent the primary source of eventual economics Ph.D.s. At the top in terms of this productivity measure is Illinois Wesleyan University, which produced one eventual economics Ph.D. in 1997-2003 for every five undergraduate economics degrees it awarded during the prior decade. Earlham, Reed, Grinnell, and Wheaton College each produced one eventual economics Ph.D for every 10 undergraduate economics degrees awarded. In comparison, Harvard produced one eventual economics Ph.D. for every 20 undergraduate economics degrees awarded, while Berkeley and Stanford produced one eventual economics Ph.D. for every 33 undergraduate economics degrees awarded.

Attrition and Completion of Economics Ph.D.s

We know of no study that examines the graduate school application decisions of undergraduates and the factors that influence their choices to apply and enroll in economics Ph.D. programs. What we do know is that nearly all of those who are admitted to an economics Ph.D. program in the US do pursue graduate study in economics. Although it is common for economics Ph.D. programs to admit students who do not enroll, in our study of nonmatriculation (Finegan et al., 2004), we estimated that only about 12 percent of those offered admission did not eventually enroll in an economics Ph.D. program in the US. Thus, for the vast majority of students, admittance into an economics Ph.D. program is the first step toward eventually completing the Ph.D.

Table 1 details the attrition and completion rates for the fall 2002 entering class of Ph.D.s. Roughly 38 percent of those who began an economics Ph.D. program in 2002 ended up dropping out of their program within 10 years, while 61 percent earned their Ph.D. within a decade. Although these overall rates of completion and attrition are favorable when compared against the roughly 50 percent attrition rate in doctoral programs in a wider range of disciplines as reported in Bowen and Rudenstine (1992) for an earlier period, the aggregate attrition and completion rates mask different trends across time and tier of Ph.D. program.

Students who begin Ph.D. study at higher-ranked Ph.D. programs are much less likely to drop out and much more likely to complete their degrees. Of the students who began their Ph.D. study at a tier 1 program[7] for example, 22 percent dropped out within 10 years, while 77 percent completed their degrees (roughly one percent are still toiling toward their Ph.D.). In contrast, 55 percent of students who began their economics Ph.D. study at tier 5 programs dropped out and only 44 percent completed their Ph.D.s within ten years.

Fortunately, for the sake of minimizing new opportunity costs, nearly three fourths of the 38 percent of new students who eventually dropout of their economics Ph.D. programs do so within the first two years of study. The two-year attrition rate was 28 percent for the entering class of 2002. For most programs, attrition rates decline monotonically after the first two years, falling to 6 percent during the third through fifth years and to 4 percent during years six through 10. The one exception is among tier one programs, where the year 6 through year 10 attrition rate of 8 percent is higher than the attrition rate between the third and fifth year of study (1 percent) and is higher than the 6-10 year attrition rate at lower-tier Ph.D. programs. Thus, it appears that although students at lower-ranked programs are more likely to eventually drop out, they do so earlier than

[7] We assigned the programs in our data to tiers based on the 1993 National Research Council (NRC) ratings (Goldberger, et al., 1995). Tier 1 in the ratings consists of Chicago, Harvard, MIT, Princeton, Stanford, and Yale. The second tier is California-Berkeley, Columbia, Michigan, Minnesota, Northwestern, Pennsylvania, Rochester, UCLA, and Wisconsin. The third tier is the 15 programs ranked 16-30 (UC-San Diego, NYU, Cornell, Cal-Tech, Maryland, Boston University, Duke, Brown, Virginia, UNC-Chapel Hill, University of Washington, Michigan State, University of Illinois-Urbana, Washington University-St. Louis, and the University of Iowa). The fourth tier programs ranked 31-48, and the fifth tier includes the remainder of the programs. The one unranked program in our study was assigned to Tier 5

those at tier one programs, perhaps because the opportunity cost of dropping out of a higher-ranked Ph.D. program is higher.

In addition to finding differences in attrition and completion across tiers, our earlier studies found that those enrolled in programs where shared offices were available to at least some first year graduate students, students with higher verbal and quantitative GRE scores, and students on research assistantships were less likely to drop out, as were males and students who earned their undergraduate degrees from foreign universities or from top liberal arts colleges in the US (Siegfried and Stock, 1999, 2001, 2004; Stock and Siegfried, 2006).

Characteristics associated with higher probability of completion include whether students were in programs where faculty members have regular monthly or bi-monthly contact to check on the progress of students seeking a dissertation topic, US citizenship, male gender, holding an undergraduate degree in mathematics, and having earned an undergraduate degree at a non-elite foreign institution as compared to a non-elite US institution. A factor associated with lower probability of finishing is the absence of first year financial aid, although once characteristics correlated with receiving aid and completing a degree are controlled, financial does not seem to exert an independent effect on the probability of completion.

We also uncovered differences in completion probabilities across gender and citizenship. Males and non-US-citizens are more likely to complete their economics Ph.D.s than their female and US citizen counterparts. Among women, but not men, the probability of completion is higher for those at Ph.D. programs with higher faculty-student ratios, at private universities, at programs that do not offer a terminal master's degree, at programs where a higher percentage of students write dissertations consisting of a set of essays rather than a traditional treatise, and from programs where there is a more flexible time limit for completing the Ph.D. (compared to programs where there is a strictly-enforced time limit for completion). Women (but not men) who hold undergraduate degrees in math (whether combined with an economics major or not) are also more likely to complete their degrees. Women who hold prior graduate degrees upon beginning their economics Ph.D. study are less likely to complete their degrees than women without this credential. Among men (but not women), analytical GRE scores, and

type of undergraduate institution attended (top liberal arts and foreign institution) are associated with higher degree completion probabilities.

Factors associated with degree completion among US citizens and among non-US citizens include the finding that for US citizens (but not foreign students) those who attended a tier 1 or 2 program had lower probability of degree completion within eight years than their peers at lower-tier programs. Attending a program where faculty advisors had regular meetings with their dissertation students is associated with higher probability of completion among US citizens, but not among non-US citizens. Among non-US citizens (but not US citizens), analytical GRE scores and holding undergraduate degrees in math are associated with higher degree completion probabilities.

Despite our findings that a few program and demographic characteristics do relate to the probability of economics Ph.D. completion, many factors that we anticipated would influence degree completion do not appear to matter. At the program level, these include whether the program required the students to pass a core exam before the start of the second year and whether the program generally offers more than five years of full financial aid. Student characteristics that do not appear to influence completion include the student's age at entry into the Ph.D. program and whether the student indicated a particular economics subfield of interest on their program application.

The small number of student credentials and program features found to be strongly associated with successful completion of doctoral studies in economics means that we are able to explain only 17 percent of the variation in the probability of completion within 8 years and only 12 percent of the variation in the probability of completion within 5 years. We believe that the low explanatory power of these characteristics is evidence that Ph.D. admissions committees do well in assessing the objective measures of likely success across applicants. The low level of explanatory power also suggests that it is not easy to make changes in the features of an economics Ph.D. program that will predictably lead to faster student completion—although providing access to shared offices for first-year students appears to be an important exception.

Time to degree

Most students entering economics Ph.D. programs survive the critical first two years of graduate education and go on to complete their degree. Additional time taken to complete the degree may generate benefits in terms of training and mentoring but it also creates opportunity costs in the form of foregone earnings and potential job opportunities.

We have examined time to degree outcomes for three separate groups of economics Ph.D. students, the cohorts of students who completed their Ph.D.s in either 1996-97 or 2001-02 and the entering Ph.D. class of fall 2002, the majority of whom completed their economics Ph.D.s between 2007 and 2009.

The bottom row of Table 1 summarizes the median years to degree by tier for the entering class of fall 2002 (graduating, on average, in 2008). The median time to degree for the cohort is 5.67 years. The time to degree is only significantly different from this median for students at tier 5 institutions, for whom the median time to degree is 5.83, or about two months longer than for those in the other tiers.

Table 2 compares time to degree and yearly completion rates for the three cohorts of Ph.D.s that we study. Because the class of 1997 and class of 2002 samples contain only cohorts of completers, we are able to report the "final" median years to degree for both of these groups. For the entering class of 2002, there are still three individuals toiling away on their degrees, so we cannot report the final median years to degree for this group; instead we report only median years to degree for those who finished within ten years.[8]

The comparison of time to degree across the three cohorts reveals that the time taken to earn the economics Ph.D. has lengthened by roughly five months over the past 15 years, from 5.25 to 5.42 to 5.67 years. Most of this increase appears to result from a reduction in the percentage of students in the left tail of the time to degree distribution. For the classes of 1996 and 2002, roughly 13 percent of the students completed their Ph.D. within four years of matriculation. For completers in the entering class of 2002, only 2 percent were able to earn a degree this quickly. Alternatively, much larger proportions of the entering class of 2002 completed their degrees in years five and six. Pushing against the rising time to degree for the later cohort is the smaller fraction of

[8] Nonetheless, because the time to completion for the three individuals will not result in a noticable shift in the median time to degree for the cohort, we are confident that the "final" years to degree for the entering cohort will not move markedly from 5.67 years.

students finishing their Ph.D. after eight years for the entering class of 2002. While 12 percent of the classes of 1997 and 2002 completed their degrees in nine or more years, only 4 percent of the entering class of 2002 did so. Overall, our data indicate a reduction in the variance of time to degree across the cohorts, as well as an upward shift in the median time to degree.

Job Market Outcomes

For the roughly 60 percent of entering Ph.D. students who complete their degrees, the job search begins the career shift from "student" status to "employee" status. As part of our investigation of the job market outcomes of economics Ph.D. students, we surveyed the graduating classes of 1997 and 2002 to inquire about their job outcomes, including their employment sector and salary.[9] We supplement these data in Table 3 with information from the NSF Survey of Earned Doctorates (SED), which provides a census of data for graduating cohorts in each year. Using the SED, we report the employment sector distribution of graduates into academe, business/industry, and government across time, including for 1997 and 2002 (the years of graduation for two of our samples) as well as for 2008 (the most common year of graduation for our entering cohort of economics Ph.D. students). We also report outcomes for the class of 2011, the most recent SED data available.

The percent of employed graduates who took jobs in academe fell from 64 to 56 percent between 1997 and 2002, and then rose slightly in later periods. Business/industry employment rose slightly across the cohorts, from 14 percent in 1997 to near 18 percent in later years. The percent taking jobs in government rose from 9 percent in 1997 to 15 percent by 2011.

Not shown in Table 3 is the international distribution of graduates' jobs, for which we have information from the classes of 1997 and 2002 (Siegfried and Stock, 1999, 2004). Twenty-three percent of employed new Ph.D.s in the class of 2002 found jobs outside the US, down from 31 percent for the class of 1997. The largest numbers of non-US jobs were located in Canada, followed by South Korea, the UK, and Brazil, Taiwan, and

[9] Because our study of the entering class of 2002 was focused on attrition and completion, and because the students finished their Ph.D.s in different years, we did not formally survey that group regarding their employment outcomes.

Turkey. Nine percent of the employed US citizens in the class of 2002 accepted employment outside the US, which is only slightly higher (and not significantly different from) the six percent who emigrated in 1996-97. In comparison, 67 percent of employed non-US citizens found employment inside the US, significantly higher than the 46 percent who landed domestic jobs in 1996-97. The international mobility of young non-US citizen Ph.D. economists appears to be growing.

Also not reported in Table 3 is the employment sector of graduates' jobs by citizenship, which we previously reported for the class of 2002 (Siegfried and Stock, 2004 Table 4). Although US citizens account for a statistically significantly larger share of those employed in research organizations (67 percent) and a smaller share of those employed in international organizations (15 percent), there is no significant difference in the percent of US citizens who find jobs in academe, business/industry, or government relative to their non-US citizen peers.

Because starting salaries rose rapidly over the course of our study, reporting starting salaries for these cohorts is not particularly informative. [10] Instead, the bottom rows of Table 3 highlight the *relative* starting salaries for graduates employed in government and business/industry as compared to those in academe. For the classes of 1997 and 2002, the data come from our surveys of graduates (Siegfried and Stock, 1999 and 2004). For the classes of 2008 and 2001, the data come from the SED, which in 2008 began asking employed graduates about their salaries. To keep the salary information consistent between these sets of samples, we compare median salaries for the cohorts without adjustment for academic-year versus 12-month salaries.

The ratio of annual salaries for those who took jobs in business/industry relative to the salaries of those who took jobs in academe is always greater than one for the cohorts, with the business/industry economists earning between 1.15 and 1.40 times as much as those in academe. The ratio of salaries for government economists relative to academic economists rose from .87 for the class of 1997, to a peak of 1.27 for the class of 2008. For the class of 2011, government economists earned about 1.2 times as much as academic economists.

[10] Nominal salaries rose from an average of $53,000 for those in 9-10 month academic positions in 1997 to $71,000 for those starting similar jobs in 2002 (Siegfried and Stock, 1999, 2002) to near $90,000 for those starting in 2010 (Deck, et al 2011).

In addition to asking about salaries and sectors of employment, we also asked graduates about their job satisfaction (Siegfried and Stock, 2004). Although those employed in business/industry earn more than their colleagues employed in most other sectors, they are less satisfied with their jobs. They view their jobs as less closely related to economics, less well connected to their education and training, and not what they expected to be doing upon graduation. Only 69 percent of them would have sought an economics doctorate if they had known at matriculation what they knew after graduation, compared to nearly 90 percent of those in the other employment sectors. Academics, on the other hand, earn lower salaries than those in other sectors, but view their jobs as more related to economics, more commensurate with their training, and more like what they expected to be doing when they began their Ph.D. study. Our research that further assesses the relationships between what economics Ph.D. students learn during their graduate programs and the skills and proficiencies they perceived as most valuable to them in their jobs is described in the next section.

Ph.D. Program Learning and Job Demands

Following the lead of the 1988 AEA Commission on Graduate Education in Economics (COGEE), we asked class of 1997 and 2002 graduates about the emphasis their Ph.D. programs placed on mastering various economic proficiencies and the importance of an array of skills for success in graduate school and in subsequent job performance (Hansen, 1991, Stock and Hansen, 2004). Although most of our survey respondents reported that the emphasis given in their Ph.D. programs to many economic proficiencies was "about right", many graduates wanted more than their Ph.D. programs delivered.

At least half of our survey respondents reported too little emphasis by their Ph.D. programs on *applying economic theory to real-world problems*, on *understanding economic institutions and history* and on *understanding the history of economic ideas*. In addition, graduates reported that skill in *application*, *communication*, and *instruction* are much more important for success in their jobs than for success in graduate school, while the opposite is true for *mathematics*. Although graduates in all sectors report that *application* skills are significantly more important in their jobs than they were in graduate

school, nonacademics have a higher probability of reporting a larger gap than do those in academe. Similarly, though graduates in all sectors report that *mathematics* is less important for success on the job than it was for success in graduate school, nonacademics report a larger gap. The gap in the importance of *creativity* is larger for academics than for those in other sectors.

Career Outcomes

In addition to tracking students during the years up to and immediately after their graduation, we also examined outcomes for the class of 1997 five and ten years after they completed their degrees (Stock and Siegfried 2006c and 2011). The most dramatic changes over the first five years in the careers of these economists are in salary growth and job mobility. In the first five years of their careers, the nominal salaries of the group grew by an average of 8.2 percent annually. Those who started full-time permanent jobs in the US in 1997 earned median salaries of $54,000 in 1997 and $80,000 in 2003. The largest salary growth was in the private sector, where salaries increased by 15 percent annually. Academic salaries rose a much more modest 5.7 percent per year. In comparison, computations using the Consumer Price Index indicate that the average annual increase in the cost of living over the same period was 2.3 percent.

This slower growth in salaries for academics led to apparent salary inversion for this group relative to newly hired economics faculty members five years later. Indeed, the median salaries of graduates of full-time permanent 9-10 month academic economists hired in 2002-03 actually *exceeded* the median 2003 salaries of their counterparts initially hired in 1997-98. Some, but not all, of this apparent salary inversion reflects a different mix of employers and departments between the two cohorts, with the younger group securing relatively more jobs at higher paying institutions.

When examining demographic and graduate school factors associated with salary growth during the early career years, we found that marriage was significantly associated with salary growth, with those who were married at the time they earned their degree experiencing roughly 15 percent higher salary growth over the first five years of their careers. For males, getting married within the first five years after graduation was associated with a 25 percent salary growth premium relative to other males. For females,

however, getting married was associated with a 23 percent salary growth penalty relative to other females, perhaps reflecting compromises incurred in a two-career job search. We did not find salary growth differences for those who graduated from higher tier relative to lower tier institutions, or for those specializing in any particular subfield of economics.

During the first five years of their careers, roughly one half (45 percent) of the economists switched employers. The largest job mobility occurred among those initially working for government, international organizations, or research organizations. Roughly 22 percent of those who started in that sector in 1997 had switched to a different sector by 2003, with the majority of the job switchers migrating into the academy. Despite the relatively low pay, only ten percent of those initially hired into academic jobs moved out of that sector during the first five years of their careers.

We also examined outcomes for the class of 1997 after ten years. Our panel of economists earned overall median nominal salaries of $54,000 in October 1997, $80,000 in February 2003, and $108,000 in March 2008, implying an annual raise of 8.2 percent over the first five years and 6.2 percent over the second five years. Those on 9-10 month academic salaries, the largest single sub-category, earned a nominal median of $49,000, $66,000, and $90,000 in 1997, 2003, and 2008, respectively, implying an annual increase of 6.1 percent over the first five years, and 6.4 percent over the second five years. These rates of increase compare to an average annual inflation rate of 2.3 percent during the first five years and 3.0 percent during the second five years of their careers. Salary growth was fastest for economists employed in government and the private sector. While nominal permanent 9-month academic salaries grew 84 percent over the decade, nominal salaries of those with full-time jobs in business and industry rose by 125 percent, and salaries of economists working in government, research institutes, and international organizations climbed by 145 percent. As expected, the dispersion of salaries grows over time. While the mean salary for all full-time jobs in the United States exceeded the median by only four percent in 1997, that difference had grown to 33 percent by 2008.

Publication records for the 1997 cohort are reported in Table 4, divided between economists who started out in academe and those who did not. The publication data were extracted from EconLit in August 2008. We report both total journal publications and

publications in "Top-50" journals.[11] We do not use total EconLit entries because many of those include working papers that duplicate subsequent publications. We also exclude publications of books and chapters in books.

The most striking observation from the publication data is the fact that almost half of the 99 economists with ten years of experience holding full-time permanent academic appointments in 2007-08 did not publish anything in a Top-50 journal in their career (the median number is one, but 49 of the 99 had zero Top-50 journal publications). The other half of the distribution includes 13 with one Top-50 publication, 25 with 2 to 5 Top-50 publications, and 12 economists with six or more publications in Top-50 journals. There are four individuals in the sample with 10-13 articles in Top-50 journals. It is ironic that the 63 economists in our sample who earned tenure have a median of zero Top-50 publications, while those who do not have tenure report a median of one. Of course their appointments are not at the same universities.

When journal articles are expanded beyond the Top-50 journals, the data show a median of five articles per full-time permanent academic, seven articles for those with tenure, and only two for those without tenure. As would be expected, those who started in academe (not all of whom were still there in 2008) published more than those who began their careers elsewhere, but the publication record of the graduates who started in a sector other than academe and then moved to an academic appointment is quite similar to those who remained in academe throughout the period.

Conclusion

In our 15 years of examining the many factors associated with students' Ph.D. attrition, completion, time to degree, and job market outcomes, several factors stand out as notable. First, the demographic makeup of economics Ph.D. students and graduates has changed markedly over time. Roughly two-thirds of the Ph.D.s in economics in the US are earned by non-US citizens, and increasingly earned by female non-US citizens. Today, female US citizens earn a smaller share of economics Ph.D.s awarded by US institutions than they did in the mid-1990s. These demographic trends are not unique to

[11] Journals among the Top-50 were determined from Kalaitzidakis et al. (2001).

economics, however, as similar patterns exist for Ph.D.s in mathematics, business, and political science.

Second, of the thousands of students who begin an economics Ph.D. program each year, almost 60 percent will eventually succeed in completing the Ph.D., while 40 percent are unlikely to do so. Among those who drop out, the majority do so within the first two years of graduate study. Factors consistently associated with higher attrition are attendance at a lower-ranked Ph.D.s program and lack of financial aid during graduate study, both of which are associated with other indicators of student quality. Indeed, once the endogeneity of financial aid is controlled, it does not appear to exert an independent impact on the probability of completing the Ph.D. Students with higher verbal and quantitative GRE scores and those who earned their undergraduate degrees from top liberal arts colleges were less likely to drop out than their peers. Males and non-US citizens are more likely to complete their economics Ph.D.s than their female and US citizen counterparts, but many of the factors related to completion differ across these groups. Despite these findings, many observable characteristics of graduate students do not appear to be systematically related to attrition and completion.

Third, the time it takes to earn a Ph.D. in economics has been inching upward over time, increasing by about five months since 1997. In addition to the slightly longer time to degree among more recent graduates, the variation in their time to degree among those who do finish has shrunk, with smaller proportions of students finishing within four years or taking nine or more years to finish.

Fourth, almost all economics Ph.D.s find employment immediately after completing their degrees. Most take jobs in academe, although the fraction of new graduates going into that sector appears to have declined since the late 1990s. Instead, graduates are increasingly taking jobs in business/industry and government, where the salaries were between 1.2 and 1.4 times larger than those of academics. Despite the salary premium, however, fewer Ph.D. economists employed in business/industry report being satisfied with their jobs and a smaller fraction of them would have sought an economics doctorate had they known at matriculation what they knew after graduation.

Fifth, although graduates perceive that the emphasis placed by their graduate programs on an array of economic proficiencies was "about right," graduates report that

skills in application and communication are much more important for success in their jobs than for success in graduate school. Alternatively, skill in mathematics was much more important for success in graduate school than for success on the job.

Sixth, almost half of new Ph.D. economists changed employers during the first five years of their careers, with the largest mobility (22 percent) occurring among those initially working in government, international organizations, or research organizations. Only about ten percent of those initially hired into academic jobs moved out of academe during their early careers. Among those in academics who we were able to track for ten years of their careers, slightly under half were able to publish their research in one of the top 50 journals in the discipline.

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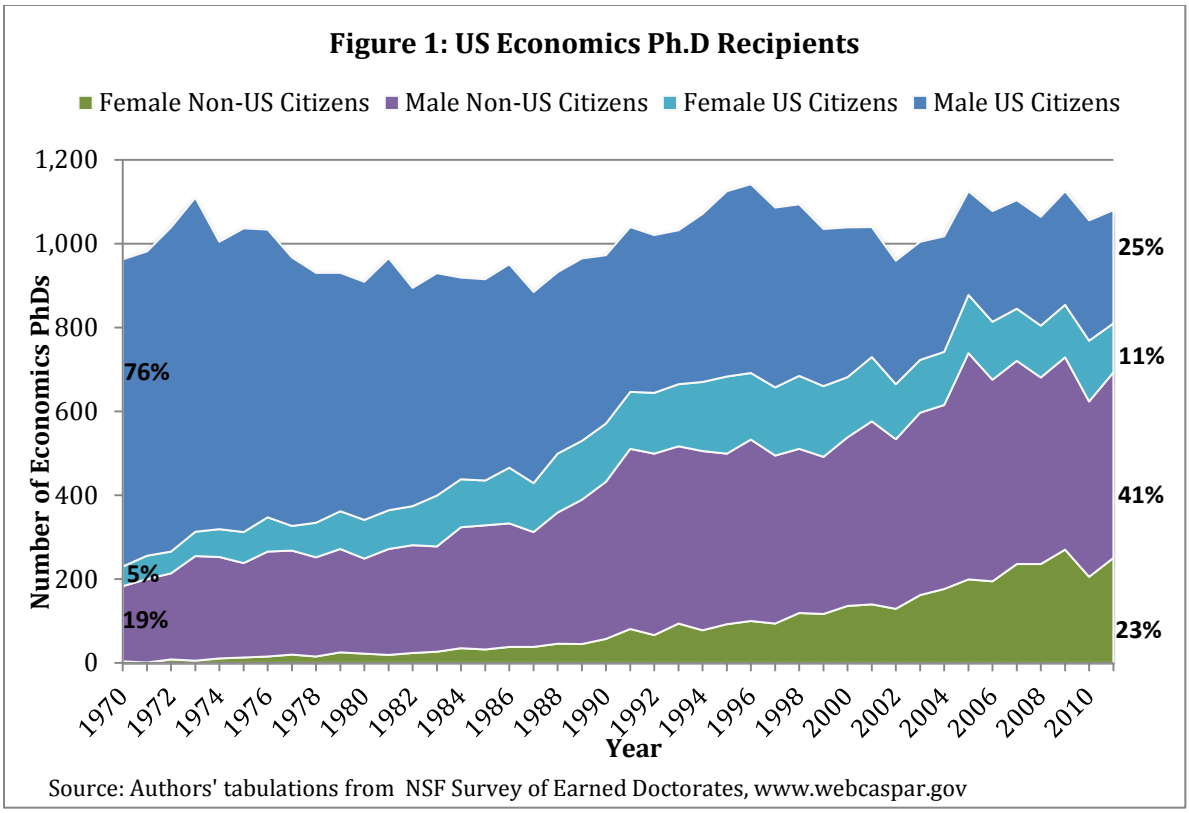


Figure 1: US Economics Ph.D Recipients
Female Non-US Citizens
Male Non-US Citizens
Female US Citizens
Male US Citizens
Number of Economics PhDs
1,200
1,000
800
600
400
200
0
76%
5%
19%
25%
11%
41%
23%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year
Source: Authors' tabulations from NSF Survey of Earned Doctorates, www.webcaspar.gov

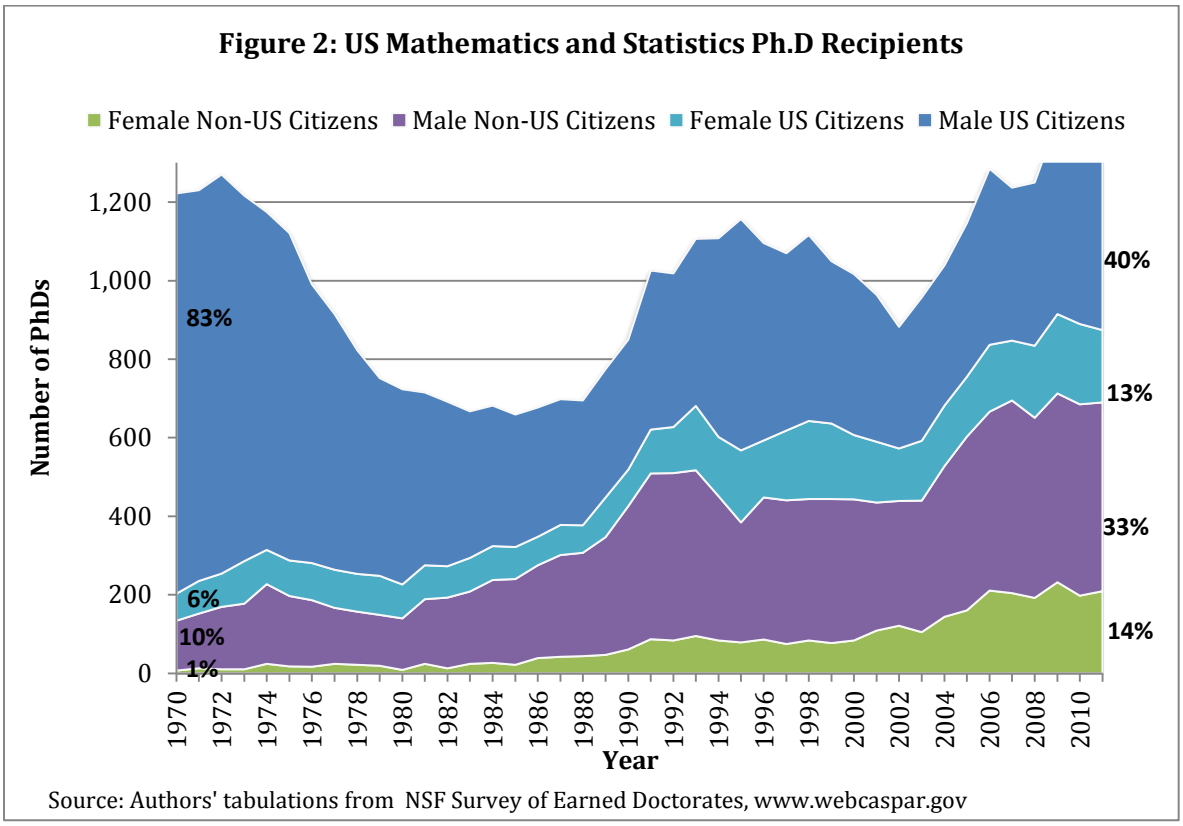
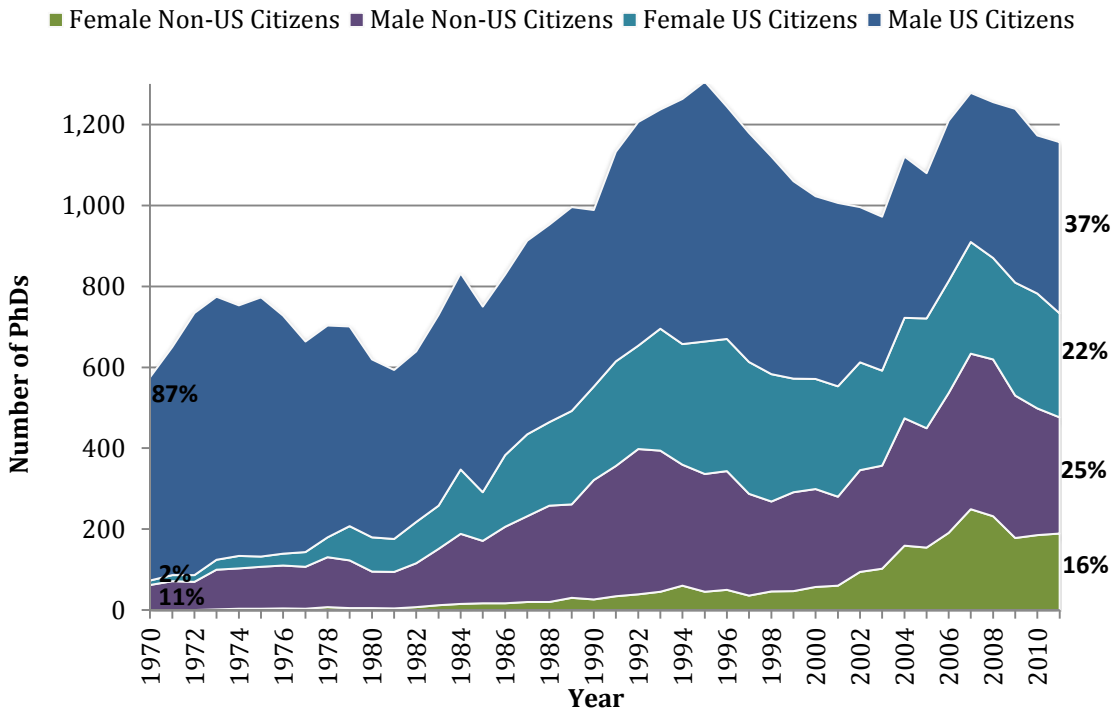


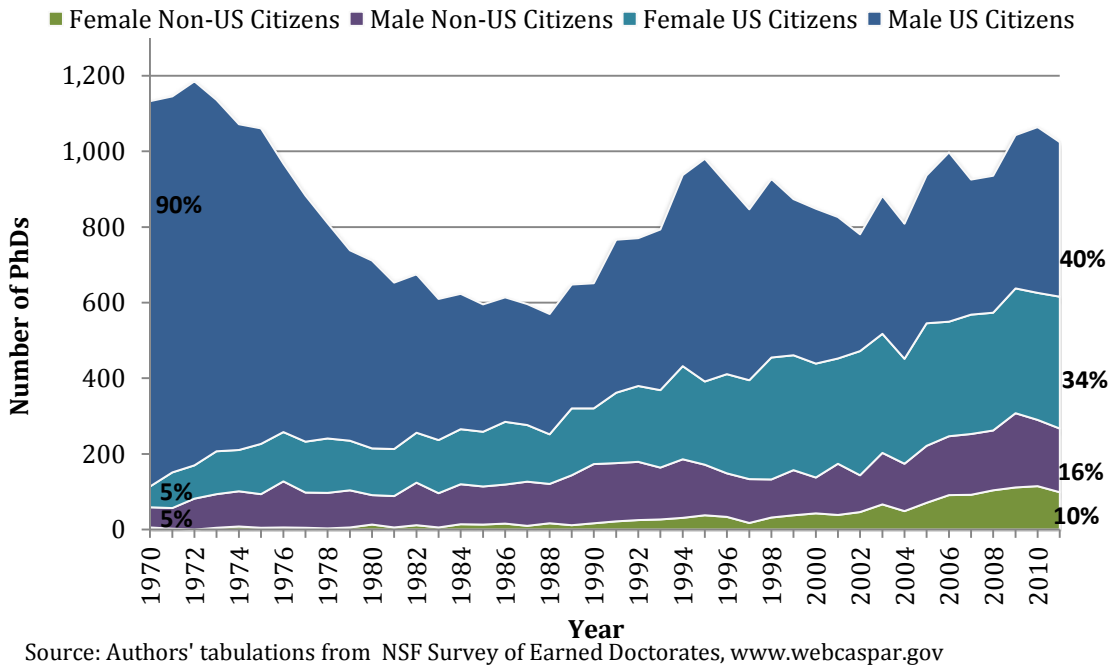
Figure 2: US Mathematics and Statistics Ph.D Recipients
Female Non-US Citizens
Male Non-US Citizens
Female US Citizens
Male US Citizens
Number of PhDs
1,200
1,000
800
600
400
200
0
83%
6%
10%
1%
40%
13%
33%
14%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year
Source: Authors' tabulations from NSF Survey of Earned Doctorates, www.webcaspar.gov

Figure 3: US Business and Management Ph.D Recipients



Source: Authors' tabulations from NSF Survey of Earned Doctorates, www.webcaspar.gov

Figure 4: US Political Science and Public Administration Ph.D Recipients



Source: Authors' tabulations from NSF Survey of Earned Doctorates, www.webcaspar.gov

Table 1 - Ph.D. Program Attrition and Completion Rates, by Program Rank

	Tier					
	1	2	3	4	5	Total
Program Rank	1-6	7-15	16-30	31-48	>48	-
Number of programs	3	6	7	6	5	27
Number of entering students, Fall 2002	103	149	141	127	66	586
First-second year attrition rate (%)	**0.14**	**0.17**	0.33	**0.39**	**0.38**	0.28
Third-fifth year attrition rate (%)	**0.01**	0.07	0.08	0.06	0.11	0.06
Sixth-tenth year attrition rate (%)	**0.08**	0.03	0.04	0.03	0.06	0.04
Total five year attrtion rate (%)	**0.15**	**0.25**	0.40	**0.45**	**0.49**	0.34
Total ten year attrition rate (%)	**0.22**	**0.28**	0.44	**0.48**	**0.55**	0.38
Five year completion rate (%)	0.33	0.32	0.26	0.24	**0.17**	0.27
Sixth-seventh year completion rate (%)	**0.41**	0.36	0.26	0.24	**0.17**	0.27
Eighth-tenth year completion rate (%)	0.03	0.05	0.04	0.03	**0.11**	0.04
Total ten year completion rate (%)	**0.77**	**0.72**	0.56	**0.52**	**0.44**	0.61
Still in program rate (%)	0.01	0.007	0.00	0.00	0.015	0.005
Median years to degree among those who finished within 10 years	5.42	5.67	5.67	5.46	**5.83**	5.67

Attrition, still in program, and completion rates are all calculated as of September 2012 relative to the original population of entering students (N=586), and are reported as percentages. Numbers in bold indicate that the rate is statistically different from the rate for the rest of the sample at the 0.05 significance level (two-tailed tests). For the years-to-degree variable, bold indicates a statistically significant difference in the tier's mean relative to the rest of the sample's mean.

Table 2 - Time to Degree for Three Cohorts of Economics Ph.D.s

	Cohort		
	Graduating Class of 1996-97	Graduating Class of 2001-02	Entering Class of Fall 2002
Median years to degree	5.25	5.42	-
Median years to degree among those who finished within ten years[a]	5.08	5.17	5.67
Fourth year completion rate[b]	0.14	0.13	0.02
Fifth year completion rate	0.25	0.29	0.38
Sixth year completion rate	0.28	0.22	0.33
Seventh year completion rate	0.13	0.18	0.18
Eighth year completion rate	0.08	0.07	0.05
Ninth year completion rate	0.04	0.04	0.02
Tenth year completion rate	0.03	0.03	0.02
Completed in more than ten years	0.05	0.05	0.007
Number of observations	584	570	363

[a] Number of observations for 1996-97 = 471; 2001-02 = 463; Fall 2002 entrants = 360

[b] The completion rates are calculated only among completers, and are reported as percentages. For the entering class of 2002, we estimated the rates based on the 360 completers plus the three students still working on their Ph.D after 10 years.

Table 3 - Employment Outcomes for Economics Ph.D.s

	1997	2002	2008	2011
Percent employed after doctorate[a]	83.7	80.2	63.2	58.4
Percent of employed in academe	63.7	55.7	59.3	56.3
Percent of employed in business/industry	13.6	18.3	18.1	16.8
Percent of employed in government	8.7	16.0	12.5	14.9
Business/industry/higher education salary ratio	1.16	1.15	1.40	1.22
Government/higher education salary ratio	0.87	1.10	1.27	1.17

Sources for percent employed by sector: NSF Survey of Earned Doctorates Summary Reports for 1997 (Appendix Table A-3a), 2002 (Appendix Table A-3a), 2008 (Table 38), and 2011 (Table 61). Percentages do not add to 100 because the nonprofit and "other" sectors are not included here.

Sources for salary ratios: 1997: Siegfried and Stock (1999) Table 3; 2002: Siegfried and Stock (2004) Table 3; 2008: Survey of Earned Dcotorates 2009 Table 45; 2011: Survey of Earned Doctorates 2011 Table 49. To keep data as consistent as possible across these samples, the ratios compare median salaries of those in academic positions (regardless of 9-10 month or 11-12 month appointment) against annual salaries in other sectors.

[a] The employment questions in the SED refer to "planned employment after doctorate" in 1997 and 2002, and "definite employment" in 2008 and 2011. The percentages in each sector are percentages of those reporting planned or definite employment plans.

Table 4 -Publication and Employment Outcomes

Group	*Median Journal Publications*	*Mean Journal Publications*	*Median Top-50 Journal Publications*	*Mean Top-50 Journal Publications*	*N*
In full-time Permanent Academic Positions in 1997	5.0	6.8	1.0	2.0	99
With Tenure in 2008	7.0	7.8	0.0	2.2	63
At same employer as in 1997	5.0	6.8	0.0	1.8	33
At different employer than in 1997	7.5	8.6	1.0	2.7	30
Without Tenure in 2008	2.0	4.1	1.0	1.6	31
Outside full-time permanent academic positions in 1997	1.0	4.0	0.0	1.3	108
In full-time permanent academic positions in 2008	6.0	7.8	1.0	2.8	34
In other postions in 2008	1.0	2.2	0.0	0.6	74

Source: Authors' survey. The subsample sizes for those in full-time permanent academic positions in 1997 do not sum to 99 because five individuals are missing information on their tenure status.